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may not his assertion be after Mr. de Courtivron's calculation, since they give a difference of time considerably greater?

I am, with the greatest regard,

Reverend Sir,

Hampton-Court  
in Middlesex.  
June 30, 1754.

Your most humble

and obedient servant,

Clairaut.

*XCIII. A Letter to the Right Honourable the Earl of Macclesfield, President of the Royal Society, concerning some new electrical Experiments, by John Canton, M.A. and F. R. S.*

My Lord,

Read Nov. 14,  
1754.

**A**S electricity, since the discovery of it in the clouds and atmosphere, is become an interesting subject to mankind; your lordship will not be displeased with any new experiments or observations, that lead to a farther acquaintance with its nature and properties.

The resinous and vitreous electricity of Mr. Du Fay, which arose from his observing bodies of the one class to attract, what those of the other would repel, when each were excited by attrition; received no light till the publication of the second part of Mr. Franklin's experiments; wherein it appears, that the one

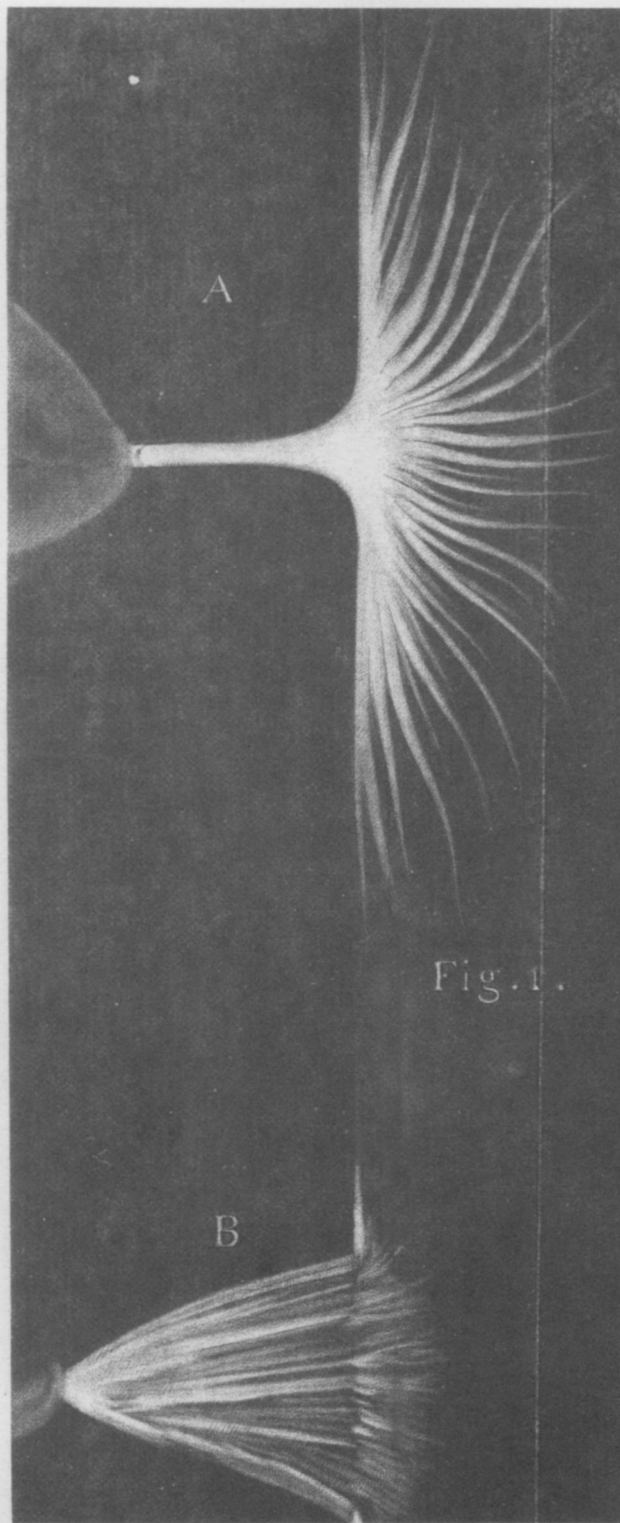


Fig. 1.

Fig. 2.



B

one kind of bodies electrify positively, and the other negatively ; that excited glass throws out the electric fire, and excited sulphur drinks it in. But no reason has yet been assigned, why vitreous bodies should receive, and resinous bodies part with this fire, by rubbing them. Some persons indeed, of considerable knowledge in these matters, have supposed the expansion of glass, when heated by friction, to be the cause of its receiving more of the electric fluid than its natural share ; but this supposition cannot be made with regard to bodies of the other sort, such as sulphur, sealing-wax, &c. which part with it when treated in the same manner. The following experiments, first made at the latter end of December 1753, and often repeated since, may perhaps cast new light on this difficult subject.

Having rubbed a glass tube with a piece of thin sheet-lead and flower of emery mixt with water, till its transparency was entirely destroyed ; after making it perfectly clean and dry, I excited it with new flannel, and found it act in all respects like excited sulphur or sealing-wax. The electric fire seems to issue from the knuckle, or end of the finger, and to spread itself on the surface of this tube, in the beautiful manner represented at *A* and *B* in *Fig. 1. Plate 32.*

If this rough or unpolished tube, be excited by a piece of dry oiled silk (especially when rubbed over with a little chalk or whiting), it will act like a glass tube with its natural polish. And in this case, the fire appears only at the knuckle, or end of the finger ; where it is very much condensed before it enters ; as at *A* and *B* in *Fig. 2.*

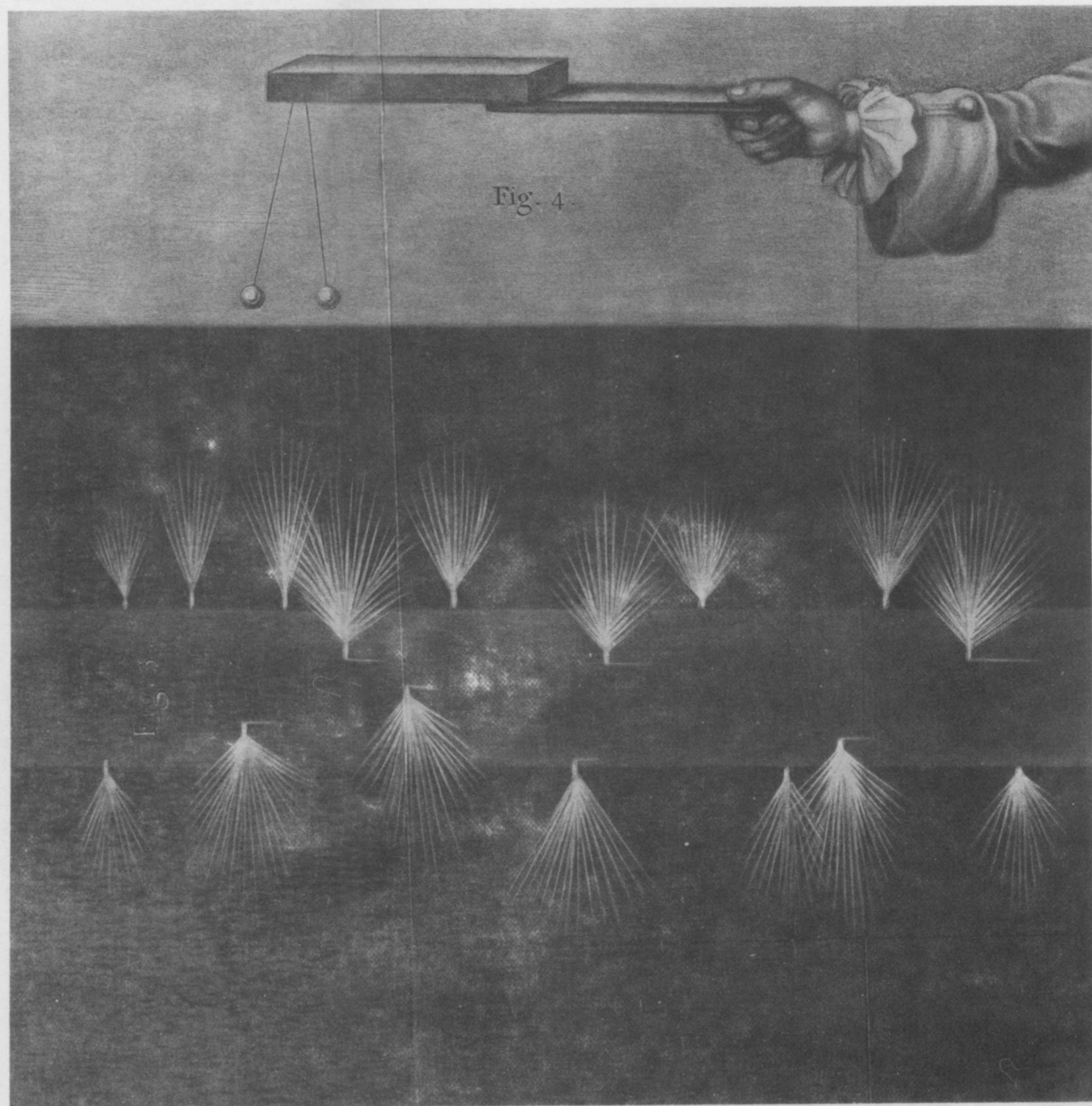
But

But if the rough tube be greased all over with tallow from a candle, and as much as possible of it wiped off with a napkin, then the oiled silk will receive a kind of polish by rubbing it, and after a few strokes, will make the tube act in the same manner as when excited at first by flannel.

The oiled silk, when covered with chalk, or whiting, will make the greased rough tube act again like a polished one: but if the friction be continued till the rubber is become very smooth, the electric power will be changed to that of sulphur, sealing-wax, &c.

Thus may the positive and negative powers of electricity be produced at pleasure, by altering the surfaces of the tube and rubber; according as the one or the other is most affected by the friction between them: For if the polish be taken off one-half of a tube, the different powers may be excited with the same rubber at a single stroke. And the rubber is found to move much easier over the rough, than over the polished part of it.

That polished glass electrifies positively, and rough glass rubbed with flannel negatively, seems plain, from the appearance of the light between the knuckle, or end of the finger, and the respective tubes; but yet may be farther confirmed by observing, that a polished glass tube, when excited by smooth oiled silk, if the hand be kept at least three inches from the top of the rubber, will at every stroke appear to throw out a great number of diverging pencils of electric fire, as in *Fig. 3. Plate 33*; but not one was ever seen to accompany the rubbing of sulphur, sealing-wax, &c. nor was I ever able to make any sensible alteration in the air of a room, merely by the friction of those



those bodies: whereas the glass tube, when excited so as to emit pencils, will, in a few minutes, electrify the air to such a degree, that (after the tube is carried away), a pair of balls, about the size of the smallest peas, turn'd out of cork, or the pith of elder, and hung to a wire by linen threads of six inches long, will repel each other to the distance of an inch and an half, when held at arm's-length in the middle of the room. But their repulsion will decrease as they are moved toward the floor, wainscot, or any of the furniture; and they will touch each other when brought within a small distance of any conductor. Some degree of this electric power I have known to continue in the air above an hour after the rubbing of the tube, when the weather has been very dry.

The electricity from the clouds, in the open air, may be discovered in the same manner, if the balls are held at a sufficient distance from buildings, trees, &c. as I have several times experienced, by a pair which I carry in a small narrow box with a sliding cover, (*Fig. 4.*) so contrived as to keep their threads straight, and that they may be properly suspended, when let fall out of it: and these balls will easily determine whether the electricity of the clouds or air be positive, by the decrease; or negative, by the increase of their repulsion, at the approach of excited amber or sealing-wax.

To electrify the air, or moisture contained in it, negatively; I support by silk, between two chairs placed back to back, at the distance of about three feet, a tin tube with a fine sewing-needle at one end of it; and rub sulphur, sealing-wax, or the rough glass tube, as near as I can to the other end, for three or four

four minutes. Then will the air be found to be negatively electrical; and will continue so a considerable time after the apparatus is removed into another room.

The air without-doors I have sometimes known to be electrical in clear weather; but never at night, except when there has appeared an aurora borealis, and then but to a small degree, which I have had several opportunities of observing this year. How far positive and negative electricity in the air, with a proper quantity of moisture between, to serve as a conductor, will account for this, and other meteors sometimes seen in a serene sky, I shall leave to the curious in this part of natural philosophy to determine. That dry air at a great distance from the earth, if in an electric state, will continue so till it meets with such a conductor, seems probable from this experiment: An excited glass tube with its natural polish, being placed upright in the middle of a room, by putting one end of it in a hole made for that purpose in a block of wood, will generally lose its electricity in less than five minutes, by attracting to it a sufficient quantity of moisture, to conduct the electric fluid from all parts of its surface to the floor. But if, immediately after it is excited, it be placed in the same manner before a good fire, at the distance of about two feet, where no moisture will adhere to its surface, it will continue electrical a whole day; and how much longer I know not. It may not be improper to mention here, that if a solid cylinder of glass be set before the fire till quite dry, it may as easily be excited as a glass tube, and will act like one in every



every respect : the first stroke will make it strongly electrical.

In a paper I laid before the Royal Society, on the 6th of December last, I conjectured, that the electricity of the atmosphere might be observed even in the winter ; which I have since found to be true : for in the succeeding months of January, February, and March, my apparatus was electrified no less than twenty-five times, both positively and negatively, by snow, as well as by hail and rain ; and to almost as great a degree, when Fahrenheit's thermometer was between 28 and 34, as I ever knew it in the summer, except in a thunder-storm.

I shall be glad, if these observations and experiments may engage persons of more leisure and superior abilities to pursue this inquiry ; as it is highly probable their researches would be rewarded by many useful discoveries. I have the honour to be,

My Lord,

Your Lordship's most obedient,

Spital-Square,  
Nov. 11, 1754.

and obliged humble servant,

John Canton.